NOTICE

U.S. Department of Transportation
Federal Aviation Administration

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Cancellation
Date: 4/2/99

SUBJ: GUIDANCE FOR THE CERTIFICATION OF AIRCRAFT OPERATING IN HIGH INTENSITY RADIATED FIELD (HIRF) ENVIRONMENTS

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1. PURPOSE. This notice provides guidance material relevant to certification of aircraft operating in High Intensity Radiated Field (HIRF) environments. Aircraft are exposed to the HIRF environments that result from high-power radio frequency transmitters such as radio and television broadcast stations, radars and satellite uplink transmitters. This notice provides a standard and uniform set of requirements for aircraft HIRF certification until a final rule can be issued. The Notice of Proposed Rulemaking (NPRM) is being developed by the FAA/JAA Electromagnetic Effects Harmonization Working Group of the Aviation Rulemaking Advisory Committee (ARAC). Aircraft electrical and electronic systems or equipment addressed by this notice may be new designs, significant modifications of existing designs, or new applications of existing systems or equipment that have not been previously certified for HIRF. This notice supersedes previous HIRF guidance.

2. DISTRIBUTION. This notice is distributed to Washington headquarters branch level of the Aircraft Certification Service and Flight Standards Service, to branch level of the regional aircraft certification directorates and regional Flight Standards Division, to all aircraft certification field offices, and to the Brussels Aircraft Certification Staff.

3. RELATED FAR SECTIONS. 14 CFR §§ 21.16, 23.1309, 25.1309, 27.1309, and 29.1309, 23.1529, 25.1529, 27.1529, and 29.1529.

4. BACKGROUND. The guidelines set forth in this notice are the result of an Aircraft Certification Service review of the existing policy on HIRF, in light of the ongoing work of the ARAC Electromagnetic Effects Harmonization Working Group. This policy also incorporates the intent and concerns embodied in the many comments received from industry and from FAA aircraft certification offices. As a result, these guidelines extend the HIRF environment to include values for use in VFR rotorcraft certification, as well as values from updated environment calculations for high-power radio frequency transmitters within western Europe, UK, and the US. This notice revises the HIRF environment levels. The Electromagnetic Effects Harmonization Working Group adopted a set of HIRF environment levels in November 1997, which were agreed upon by FAA, JAA and industry participants. As a result, the HIRF environments in this notice reflect the environment levels recommended by this working group. The HIRF environments consider the field strength from high power transmitters, and the likely

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separation distance between the aircraft and transmitters. These HIRF environments are included in the draft NPRM, which is expected to be published for public comment in 1998. This notice still includes the laboratory test level for aircraft certifications, and the modulation requirements are consistent with RTCA/DO-160D Section 20 dated July 29, 1997.

5. PROCEDURES

a. Certification Parts 23, 25, 27 and 29. For new, amended and supplemental type certificates (STC) under 14 CFR Parts 23, 25, 27, and 29, the cognizant FAA Aircraft Certification Office (ACO) will issue special conditions that require the applicant comply with either (1) or (2) as follows:

(1) The applicant may demonstrate that the operation and operational capability of the installed electrical and electronic systems that perform critical functions are not adversely affected when the aircraft is exposed to the HIRF environment, using Tables 1 or 2.

(2) The applicant may demonstrate by a system laboratory test that:

(a) The electrical and electronic systems that perform critical functions withstand an electromagnetic field strength of 100 volts per meter over a frequency range of 10 kHz to 18 GHz. This includes rotorcraft systems performing critical functions in IFR operations.

(b) The rotorcraft electrical and electronic systems that perform critical functions in VFR operations withstand an electromagnetic field strength of 200 volts per meter over a frequency range of 10 kHz to 18 GHz. When using a laboratory test to show compliance with the HIRF requirements, no credit is given for signal attenuation due to installation.

(3) Either demonstration may be used to show compliance within individual frequency ranges specified in Tables 1 or 2.

(4) With the incorporation of a HIRF environment and laboratory test level for VFR rotorcraft certification, no additional requirements will be applied for certification of installed critical systems for VFR rotorcraft. The VFR rotorcraft environment and laboratory test levels incorporated into this notice are sufficient to account for the unique low-altitude operations of rotorcraft.

(5) The fields strength values for the HIRF environment and laboratory test levels are expressed in root-mean-square units measured during the peak of the modulation cycle, as many laboratory instruments indicate amplitude. These are commonly called “peak-rms” values. The true peak field strength values will be higher by a factor of the square root of two.

b. Compliance Method. This paragraph describes an acceptable method of showing compliance with the HIRF requirements for new, amended, or supplemental type certificates.

(1) Compliance plan. The applicant should present a plan to the cognizant FAA ACO for approval, outlining how the compliance with the HIRF requirements will be attained. This plan should also propose a pass/fail criteria for the operation of critical systems in the HIRF environment.

(2) System Criticality. The electrical and/or electronic systems that perform critical functions must be identified by the applicant with the concurrence of the cognizant FAA ACO. This may be accomplished by conducting a functional hazard assessment, and, if necessary, preliminary system safety assessments (see SAE ARP 4761). The term "critical" means those functions whose failure would contribute to, or cause a catastrophic failure condition which would prevent the continued safe flight and landing of the aircraft.

(3) Candidate Systems for HIRF requirements. The critical systems identified by hazard analysis are candidates for the application of HIRF requirements. The primary electronic flight display and the full authority digital engine control (FADEC) systems are examples of systems which perform critical functions. For approval of such systems, certification criteria of paragraph 5.a. should be used. A system may perform both critical and non-critical functions. The HIRF requirements apply only to the critical functions performed by the systems to be installed.

(4) Compliance Verification. Compliance with HIRF requirements may be demonstrated by tests, analyses, models, similarity with existing systems, or a combination thereof as acceptable to the FAA ACO. Service experience alone is not acceptable since such experience in normal flight operations may not include an exposure to the HIRF environment.

(5) Pass/Fail Criteria. Acceptable system performance is attained by demonstrating that the system under consideration continues to perform its intended function. Functions performed by electrical and electronic systems, whose failure to provide that function correctly could lead to a catastrophic failure condition, would require protection to the extent that the function must not be adversely affected when the aircraft is exposed to required electromagnetic fields. These functions must continue to be provided during and after the time the aircraft is exposed to required electromagnetic fields. If the function is provided by multiple systems, then loss of one or more systems, during exposure of the aircraft to required electromagnetic fields, shall not result in the loss of the function. After the airplane is exposed to required electromagnetic fields, each affected system that performs these functions shall automatically recover normal operation, unless this conflicts with other operational or functional requirements of that system. Deviations from system specification may be acceptable and will need to be independently assessed for each application by the ACO.

(6) Test Methods and Procedures. RTCA DO-160D Section 20, and the draft HIRF user's manual provide information on acceptable procedures. Applicants that choose the compliance approaches from paragraph 5.a. may use any one of the following techniques:

(a) A low level swept coupling test to determine the internal aircraft environment in terms of the electromagnetic fields and induced cable current. The applicant must show that

this aircraft internal environment will be equal to or lower than this system laboratory qualification test level, including interconnecting cable currents and internal field strengths.

(b) A full scale aircraft test, with the critical system(s) installed and exposed, to the HIRF environment.

(c) A claim of similarity by documenting that the proposed system(s) and installation(s) have previously met the interim HIRF requirements. An approval may be sought on the basis of similarity to equipment and installations that have met the interim HIRF requirements. The claim of similarity may be based on equipment type, function, design, and installation similarities. If the claim of similarity is not found to be fully satisfactory, a bulk current injection test on the system as installed in the aircraft may be required by the cognizant ACO, over a frequency range of 10 kHz to 400 MHz, to confirm similarity.

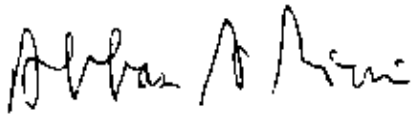
(d) The laboratory test levels of paragraph 5.a.(2) are defined according to RTCA/DO-160D Section 20 Category W (100 V/m and 150 mA) and Category Y (200 V/m and 300 mA). As specified in DO-160D Section 20, the test levels are defined as the peak of the rms envelope. As a minimum, the modulations required for RTCA/DO-160D Section 20 Categories W and Y should be used. Other modulations should be selected as the signal most likely to disrupt the operation of the equipment under test based on its design characteristics. For example, flight control systems may be susceptible to 3 Hz square wave modulation while the video signals for CRT displays may be susceptible to 400 Hz sinusoidal modulation. If the worst case modulation is unknown or cannot be determined, RTCA/DO-160D Section 20 default modulations may be used. If a system manufacturer has conducted the RTCA/DO-160D Section 20 system laboratory test approved by the FAA, the manufacturer must define installation criteria for the approved system, and define the aircraft system wiring harnesses so that they can be fabricated to the manufacturer’s installation criteria.

(e) If the critical function(s) of the system is not continually available during the test, then an alternate means of providing the critical function(s) must remain available in the aircraft. The alternate system which provides the critical function must be shown by test, analysis, or similarity to meet the HIRF requirements without interruption. During any interruption caused by the test, the system must not provide misleading information, and its failure must be immediately recognizable. After test exposure, the system must be capable of regaining normal operation of the critical function(s) automatically or by a manual means useable by the flight crew. Deviations from the pass/fail criteria may be acceptable when the effects are shown to be negligible and neither cause nor contribute to conditions adversely affecting the operational capabilities of the aircraft. When deviations occur, the applicant shall provide assessment and supporting rationale of the acceptability of such deviations. The cognizant Aircraft Certification Office (ACO) will establish final approval of such supporting documentation.

(7) Data Submittal. An accomplishment report should be submitted to the FAA ACO in fulfillment of HIRF requirements containing test results, analyses, and other pertinent data as stated in the compliance plan.

c. Maintenance Requirements. The applicant must provide maintenance requirements to assure the continued airworthiness of the installed systems. The maintenance requirements to be considered during certification include periodic inspections or tests for required structural shielding, wire shields, connectors, and equipment protection components. The applicant must provide the engineering validation and substantiation of these maintenance requirements.

d. Deviations. A proposed deviation from the above stated policy must be coordinated with the Aircraft Certification Service, Aircraft Engineering Division, AIR-100 prior to any agreement with the applicant.



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APPENDIX 1. Table 1. VFR Rotorcraft

	Field Strength (volts per meter)	
Frequency	**Peak**	**Average**
10 kHz - 100 kHz	150	150
100 kHz - 500 kHz	200	200
500 kHz - 2 MHz	200	200
2 MHz - 30 MHz	200	200
30 MHz - 70 MHz	200	200
70 MHz - 100 MHz	200	200
100 MHz - 200 MHz	200	200
200 MHz - 400 MHz	200	200
400 MHz - 700 MHz	730	200
700 MHz - 1 GHz	1400	240
1 GHz - 2 GHz	5000	250
2 GHz - 4 GHz	6000	490
4 GHz - 6 GHz	7200	400
6 GHz - 8 GHz	1100	170
8 GHz - 12 GHz	5000	330
12 GHz - 18 GHz	2000	330
18 GHz - 40 GHz	1000	420
The field strengths are expressed in terms of peak root-mean-square (rms) values.		

APPENDIX 2. Table 2. All Other Aircraft

	Field Strength (volts per meter)	
Frequency	**Peak**	**Average**
10 kHz - 100 kHz	50	50
100 kHz - 500 kHz	50	50
500 kHz - 2 MHz	50	50
2 MHz - 30 MHz	100	100
30 MHz - 70 MHz	50	50
70 MHz - 100 MHz	50	50
100 MHz - 200 MHz	100	100
200 MHz - 400 MHz	100	100
400 MHz - 700 MHz	700	50
700 MHz - 1 GHz	700	100
1 GHz - 2 GHz	2000	200
2 GHz - 4 GHz	3000	200
4 GHz - 6 GHz	3000	200
6 GHz - 8 GHz	1000	200
8 GHz - 12 GHz	3000	300
12 GHz - 18 GHz	2000	200
18 GHz - 40 GHz	600	200
The field strengths are expressed in terms of peak root-mean-square (rms) values.		